ton is equally gifted, and there is quite remarkable merit in the drawings by Mr. A. K. Maxwell.

One of Mr. Budgett's discoveries was a fresh-water medusa in the delta of the Niger. According to Mr. E. T. Browne this is referable to the species (*Limnocnida tanganicae*) that has been found in Lake Tanganyika, and its occurrence in these widely-separated localities becomes intelligible if we regard it as a relic of the fauna of the Lutetian Sea, which the geologists believe to have stretched across Africa in Middle Eocene times. Mr. Browne gives an interesting account of this remarkable type, which remains unclassifiable. There is probably a gymnoblastic hydroid stage awaiting discovery.

The volume is an eloquent tribute to the esteem in which Mr. Budgett was held by his friends, for besides the editorial labours and Mr. Shipley's beautifully executed sketch, the working-up of the embryological material—especially that which fell to Prof. Graham Kerr and Mr. Assheton—must have involved much time and thought. Those who have by their own masterly work thus completed Budgett's have certainly been generous in their friendship, and the memorial volume, which is a valuable contribution to embryology, will surely not fail of its highest purpose, of perpetuating by its stimulus the tradition which Budgett's life and work expressed.

HIGHER ALGEBRA AT HARVARD UNIVERSITY.

Introduction to Higher Algebra. By Maxime Bôcher. Prepared for publication with the cooperation of E. P. R. Duval. Pp. xi+321. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1907.) Price 8*s.* net.

WITH the cooperation of a former pupil, Mr. E. P. R. Duval, Prof. Bôcher has made into a book part of the subject of his lectures during the last ten years. Of course, it would be unfair to try to reconstruct the lectures from the book, but we do get an impression from this volume, and especially from the preface, of the problems which a Harvard professor has to face, and how he deals with them. We are told that

> "An American student approaching the higher parts of mathematics usually finds himself unfamiliar with most of the main facts of algebra, to say nothing of their proofs. Thus he has only a rudimentary knowledge of systems of linear equations, and he knows next to nothing about the subject of quadratic forms."

For a student of this kind Prof. Bôcher provides a book which contains the elementary theory of polynomials, determinants, systems of linear equations, matrices, invariants, and symmetric functions, besides a discussion of quadratic forms which goes into considerable detail, and is based on the work of Smith, Sylvester, Weierstrass, and Kronecker.

The author makes special mention of Kronecker and Frobenius, and, in fact, it is easy to see how these great analysts have influenced the writer both in his choice of topics and mode of treatment. Whatever may be thought about the subjects discussed, there is no doubt about the soundness and thoroughness of the treatment; and it would be very interesting to know what is the effect of a course of this kind upon a class of American students, and what would be the result of giving it to an English class of a similar grade. It ought at least to arouse interest, and would probably induce the best students to read some first-rate memoirs, and possibly produce something of their own—though it must be confessed that the theory of quadratic forms, which is the *terminus ad quem* of this book, has been so thoroughly worked out now that there does not seem much chance of developing it further.

It should be stated that Prof. Bôcher by no means confines himself to abstract analysis; on the contrary, like Klein, he takes every opportunity of giving geometrical interpretations, and although he does not say so, it is likely enough that he has illustrated by diagrams and models the different ways in which two proper or degenerate quadric surfaces may intersect. Some of his groups of examples are calculated to suggest methodical lines of research in other directions; for example, on pp. 260–61 we have an outline of the theory of the binary quartic.

Generally speaking, the style of the book is very clear and simple. One exception occurs on p. 120, theorem 2, where it is not sufficiently emphasised that in the first case $\Sigma a_{ij}x_iy_j=0$ is to be made an identity in the x's by giving suitable fixed values to the y's. And although the notion of a domain of rationality is explained (pp. 175, 212, 216), it would have been better to do this at an earlier stage.

The printing, done at the Norwood Press, is very good on the whole, but the suffixes are often unpleasant to look at, owing to want of gradation in type. On the other hand, we do find $x_2''^2$ printed nearly as it is written—a very rare experience in English-printed books. It would serve a useful purpose if a congress could be held between mathematicians and mathematical printers and compositors; the former often forget that what is easy to write may be difficult to print, and the latter are very conservative, besides failing to sympathise with a mathematician's way of writing formulæ, especially in matters of proportion and spacing.

G. B. M.

METEOROLOGICAL OBSERVATIONS.

The Observer's Handbook, Meteorological Office, 1908. A new and revised edition of Dr. R. H. Scott's "Instructions in the use of Meteorological Instruments." (London: H.M. Stationery Office.)

THIS book consists of two parts, and appendices. Part i. follows somewhat in the line of Dr. Scott's handbook, but part ii. is practically new, and deals with recording instruments, several of which have come into use since the previous book was published.

The issuing of a new official guide for its observers by the Meteorological Office gives an opportunity of comparing the state of the science of meteorology now and twenty years ago, in so far as instruments and

©1908 Nature Publishing Group

observations are concerned, and in two respects the book shows considerable advance. Thus twelve pages are devoted to the Campbell Stokes sunshine recorder, and full instructions for setting the cards and adjusting the instrument are given, although the measurement of sunshine is not mentioned in the old book. Also the doubt about the measurements of wind velocity by the Robinson anemometer and the relation between the recorded velocity and the numbers of the Beaufort scale has been to a great extent removed. A useful classification of the scale, and a description of the results produced both on sea and land by the winds denoted by the various numbers, are given. Notwithstanding this, a man must be more than human if his estimation is entirely free from the influence of the prevailing conditions to which he has recently been exposed. A scale of fog intensity based on the inquiry supported by the London County Council in the winter of 1902–3 is also given.

Feinman's nephoscope and Besson's comb nephoscope are described. Probably the authors are not to blame, but it is a pity that cloud velocities are not measured in angular velocities, or rather angular velocities reduced to the zenith, the tangential velocity of the handbook. Certainly angular velocity is the only physical quantity in which cloud motion as seen from a single station can be expressed. It seems absurd, and is certainly very far from the truth, to assume that all clouds are at a height of 1000 metres, or that all clouds are moving with a linear velocity of 1 metre per second. Why, too, should the term "relative" be used? If relative means angular, as appears from the context, its use is incorrect, and although sanctioned by past usage, it would be well to give up the incorrect use of a technical word.

In the chapter dealing with the corrections to be applied to the barometer, it might have been well to point out that the reading in windy weather is to some extent dependent on the position of the room, and the way in which openings from it are situated with regard to the wind direction. There is plain evidence that an important error may be so produced.

The appendices consist of the usual tables and a memorandum by Dr. Shaw on the important question of units. In it Dr. Shaw points out the objections to both the systems now in use. To avoid the trouble of negative temperatures he advocates the use of the absolute centigrade scale, omitting the first figure, which will almost always be 2. This would be a vast improvement, and would earn the gratitude of all who have to obtain mean temperature values for places in temperate latitudes. In addition to the question of negative values, the muddle of having two systems is most pronounced in the case of temperature, for the alternative values cannot be read off from a slide-rule, as they may be for the barometer and the rainfall. An entirely fresh system has perhaps a better chance of general adoption than either of those now in use.

The handbook is carefully prepared, and contains much interesting matter, and Mr. Lempfert is certainly to be congratulated on its publication.

SOME PHYSICAL TEXT-BOOKS AND LECTURES.

(1) *Theorie der Elektrizität.* Vol. i., Einführung in die Maxwellsche Theorie der Elektrizität. By Dr. A. Föppl. Third edition, edited by Dr. M. Abraham. Pp. xviii+460; illustrated. (Leipzig: B. G. Teubner, 1907.) Price 12 marks.

(2) *Kleiner Leitfaden der praktischen Physik.* By Dr. F. Kohlrausch. Second enlarged edition. Pp. xviii+268; illustrated. (Leipzig and Berlin: B. G. Teubner, 1907.) Price 4 marks.

(3) *Die Stimmgabel: ihre Schwingungsgesetze und Anwendungen in der Physik.* By Dr. E. A. Kielhauser. Pp. viii+188; illustrated. (Leipzig: B. G. Teubner, 1907.) Price 6 marks.

(4) *Luft, Wasser, Licht und Wärme.* By Dr. R. Blochmann. Third edition. Pp. vi+149; illustrated. (Leipzig: B. G. Teubner, 1907.) Price 1.25 marks.

(5) *Moleküle, Atome, Weltäther.* By Dr. G. Mie. Second edition. Pp. iv+142; illustrated. (Leipzig: B. G. Teubner, 1907.) Price 1.25 marks.

(6) *Die Stellung der Physik zu den Naturwissenschaften und der Technik.* By Aug. Hagenbach. Pp. 25. (Leipzig: B. G. Teubner, 1907.) Price 0·80 mark.

(1) OF this group of volumes the first is undoubtedly the most important. Since, however, it is the third edition which is before us, and very few changes have been made, it calls only for a short notice. These changes consist of alterations in the arrangement of the matter and a revision of the text here and there wherever it was found possible to make the exposition clearer. These changes have been made under the editorship of Dr. M. Abraham. The result is to improve a book of exceptionally high standing. We do not hesitate to affirm that we have in it one of the best expositions of Maxwellian doctrine, and at the same time one of the best introductions to vector analysis.

(2) This also is an improved edition (the second). For a "smaller" text-book it contains an enormous amount of information useful for general reference. This information is necessarily very condensed. In some cases it will probably be found insufficient by anyone except an expert experimentalist; that is to say, by one (for example, a chemist) who, though proficient in laboratory work, is not acquainted specially with practical physics, and wishes for hints in regard to physical processes.

(3) A monograph on the tuning-fork and its applications is a very welcome addition to physical literature. This one is based upon about eighty original papers published mainly since 1870; these lie within the period during which most work on this instrument has been done. When it is stated that the volume is non-mathematical, it will be obvious that it does not by any means profess to be complete; it will also be understood how it is that there are only two references to Lord Rayleigh in it, and that his "Theory of Sound" is not quoted in the list of consulted books at the end. This limitation in the treatment excludes many of the most interesting problems in connection

©1908 Nature Publishing Group